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ABSTRACT

The Abort Advisory System (AAS) as it exists at MILA/ETR is primarily designed for use in an "advisory" capacity during manned launch operations at LC-39 or LC-34. The AS-502 mission, however, will present a one-time special case in that an "abort-request" signal from the AAS will actually initiate the abort sequence. Responsibility for initiation of an abort-request will rest with the Launch Operations Manager (LOM) from the time the LES is armed until the space vehicle clears the LUT.

For AS-502, there will be two links between the AAS and the spacecraft prior to liftoff--an abort-request hardline from the abort console through the IU umbilical and a 450 mc uplink through the ETR UHF transmitter. However, the actual "abort command" can only be sent via the 450 mc uplink while the hardline will function as it would during manned operations by lighting the abort-request light in the CM. The S-Band uplink capability of the AAS to send an abort-request signal will be absent for AS-502 since it is not planned to provide the necessary software for the USB command computer.

The AAS has not, to date, experienced an adequate end-to-end test, nor has it participated in an overall Apollo system test. The first integrated test of the AAS is currently planned to follow the EDS test during the AS-502 Spacecraft Reverification Test scheduled for February 15. Overall system tests prior to launch countdown involving AAS participation will be the Flight Readiness and Countdown Demonstration Tests.

SUBJECT:	Status of Apollo Abort Advisory System (AAS) for AS-502 - Case 320	DATE:	February 1, 1968
		FROM:	C. H. Eley III

MEMORANDUM FOR FILE

The initial design concept of the Apollo Abort Advisory System (AAS) was originally envisioned as a KSC system to be remotely operated by MSC. Later considerations of a possible pad catastrophe led to expanding the AAS to also include operational capability by KSC. Whereas the Abort Advisory System is primarily designed for use in an "advisory" capacity, the AS-502 mission will present a special case in that an "abort-request" from the AAS will actually initiate an abort. This paper discusses the current status of the AAS with respect to design and implementation at Launch Complex 39 for AS-502 and future Apollo/Saturn launches. Information presented has been obtained from recent meetings at KSC and informal discussions with personnel at Goddard and the KSC/USB site.

1.0 GENERAL

From T-10 minutes in the AS-502 countdown (when the pyro and logic buses are armed) until the vehicle clears the LUT following liftoff, the Launch Operations Manager (LOM) will have the capability to initiate a spacecraft abort. During the countdown for all other (except BP-30) missions, the LOM will only be able to send an "abort request" signal which illuminates a light on the main display console in the CM. It is then the responsibility of the flight crew to actually initiate the abort. In the case of manned vehicle countdowns, the LOM will have an abort-request capability soon after the CM access arm is withdrawn. The following are the abort conditions for manned or unmanned spacecraft under which the Launch Operations Manager would have to initiate abort/abort request action:

a.   An uncontrollable fire which would result in the loss of the spacecraft

b.   An explosion which would result in the loss of the spacecraft

    c.   A situation prior to tower clearance where
the launch vehicle loses positive vertical
motion

    d.   When tipover of the space vehicle is apparent

    e.   Any structural failure of the launch vehicle
which would result in loss of the spacecraft.

2.0 SYSTEMS DESCRIPTION

Figure 1 is a simplified block diagram of the
Abort Advisory System as it exists in the MILA/ETR area for
use at LC-39. The abort console shown in Figure 1 is located
in each of the firing rooms (Firing Rooms 1, 2, or 3) in the
LCC at LC-39. Each of the consoles located in the firing
rooms is identical, however only one can be active at a time.
There is also an abort console in the LC-34 blockhouse. Each
console is comprised of the following four panels:

    a.   Cue-Info Panel

    b.   Television Monitor Panel

    c.   Television Switching Panel

    d.   Abort Panel.

Panels (a), (b), and (c) above are used only to
provide information to the Launch Operations Manager. The Cue-
Info Panel, (a) above, contains six display lights, four of
which are used to indicate a hazardous status to the LOM.
These cue-lights are not part of an automatic system, but are
manually initiated by personnel at remote locations. The
following is a list of the cue-indications together with the
criteria for activation and the applicable time frame.

	Cue-Light	Activation Criteria	Time Frame
1.	Thrust Chamber Press.	Loss of pressure on one F-1 engine thrust chamber	From liftoff to tower clearance
2.	Engine Gimbal Position	One engine hardover	From engine ignition to tower clearance
3.	Tank Pressure	Common Bulkhead Δp unsafe	LES arm to tower clearance
4.	Hazardous Gas	Dangerous GH_2 concentration	LES arm to T-5 seconds

Responsibility for initiating the first three cue-lights above rests with those particular system engineers who are monitoring real time readouts on strip charts in the CIF. Hazardous gas monitoring is done by personnel in the LCC.

The Abort Panel, (d) above, provides the means of initiating an abort-request (or in the case of 502, an abort-command). The Abort Panel also contains eight indicators displaying such information as ordnance-safe/armed, ETR/USB command carrier status, etc. There are also indicators which show when an abort request is enabled, initiated, and received by the spacecraft. The last indicator on the panel, labeled "S/C Abort," is only activated when the AAS receives a signal that LES has fired and CM/SM separation has occurred. If the LOM wishes to initiate an abort, the procedure is to first place the switch located on the abort panel labeled Abort Request "A" in the ON position and then back to the OFF position. This is followed using the same procedure with the Abort Request "B" switch which acts as a backup.

As shown in Figure 1, the abort request signal (or in the case of AS-502, the "abort command" signal) is sent via either of two channels labeled Abort Request "A" and Abort Request "B." Each of these abort commands is sent to the abort sequencer located at the USB site. Either the "A" or "B" command once initiated is sent to the abort sequencer over three guarded hardline circuits. The abort sequencer must receive a signal on at least two of the three hardlines for either of the "A" or "B" abort requests. The reason Abort "A" and Abort "B" are initiated separately in the procedure is that the abort sequencer clears, selects and executes the abort requests on a priority basis; that is, whichever one is received first.

The abort request (or command) itself is actually stored in the command computer located at the USB site (see Figure 1). The job of the abort sequencer is to get the command computer to issue the abort command. It does this with a 30-bit coded word. MCC-H abort requests do not go through the abort sequencer, however, but through GSFC via a hardline direct to the USB command computer itself. After a command from either KSC or MSC, the command computer issues a 1 kilobit signal through the 201B data modems to the Down Range Uplink (DRUL) where the digital command is converted to drive the UHF command transmitter. The UHF command transmitter uplinks the abort command to the spacecraft via 450 mc. The spacecraft will confirm when an abort-request has been received including CM/SM separation through the "S" Band and VHF downlinks.

In future missions, the USB command computer would also send an abort-request through the USB S-Band transmitter. For AS-502, however, the S-Band uplink will not be used since the actual software required for an S-Band abort-request will not be in the command computer.

The abort-request hardline shown in Figure 1 leading from the abort console to the S/C (through the IU umbilical) provides a link only during the time prior to vehicle lift-off. Abort "A" or "B" will send a signal through the hardline. This will <u>not</u>, however, command an abort in AS-502 but will only power the abort request light in the spacecraft. The actual abort command link for AS-502 will be only through the UHF 450 mc uplink.

3.0   SYSTEM SAFETY

The AAS system will not be "hot" until the vehicle pyro and logic buses are armed <u>and</u> all safety checks are removed. There are three points at which the system is safed. All are at the USB site. Two of these are manual RF-inhibit switches located on the output side of the command computer (see Figure 1). The third switch, also manual, is a logic-inhibit switch located between the abort sequencer and the command computer.

Prior to arming logic and pyro buses (LES Arm) during countdown, the position of the RF-inhibit switches are controlled by MSC since they are using the UHF system to send other uplink commands to the spacecraft. The logic-inhibit switch between the abort console and the abort sequencer is physically located at the USB site, but the safe/arm position of the switch is controlled by voice command from the Launch Operations Manager. The LOM, however, can only assess AAS status via the OIS and the status lights on his abort console which come from the abort sequencer console at the USB site. Operators at the USB site will only send a green light indicating a "hot" system after they have placed all three inhibit switches in the "arm" position and the system is ready.

The abort console itself also contains a safety measure to insure positive control of power to the Abort Request switches. This is in the form of a rotation switch located on the abort panel labeled "Enable." The Enable switch requires insertion of a key in order to turn the switch and close the power circuit up to the Abort Request switches. During the countdown for AS-502, it is currently planned to power the abort console at T-45 minutes. The pyro and logic buses will be armed at T-10 minutes. For manned missions from LC-39 and LC-34, the pyro and logic buses will be armed following spacecraft closeout and removal of the access arm (about T-29 minutes).

The Abort Advisory System has not, to date, experienced an adequate end-to-end test, nor has it participated in an overall Apollo system test. The first integrated test for the AAS is presently planned during the Spacecraft Reverification Test scheduled for February 15. The scheduled overall tests (prior to a launch) involving AAS participation will be the AS-502 Flight Readiness Test and Countdown Demonstration Test.

2032-CHE-gmp   C. H. Eley III

Attachment
    Figure 1

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References

1. "Apollo/Saturn V SV OAT #2 (Plugs Out - Apollo 6) TCP" Revision 1, dated January 7, 1968.

2. "Apollo/Saturn V Abort Command/Request Ground Rules Procedures and Systems Description." KSC document dated January 1968.

3. "Launch Directors Abort Advisory System" by MSF Operations Division, MILA USB dated October 25, 1966.
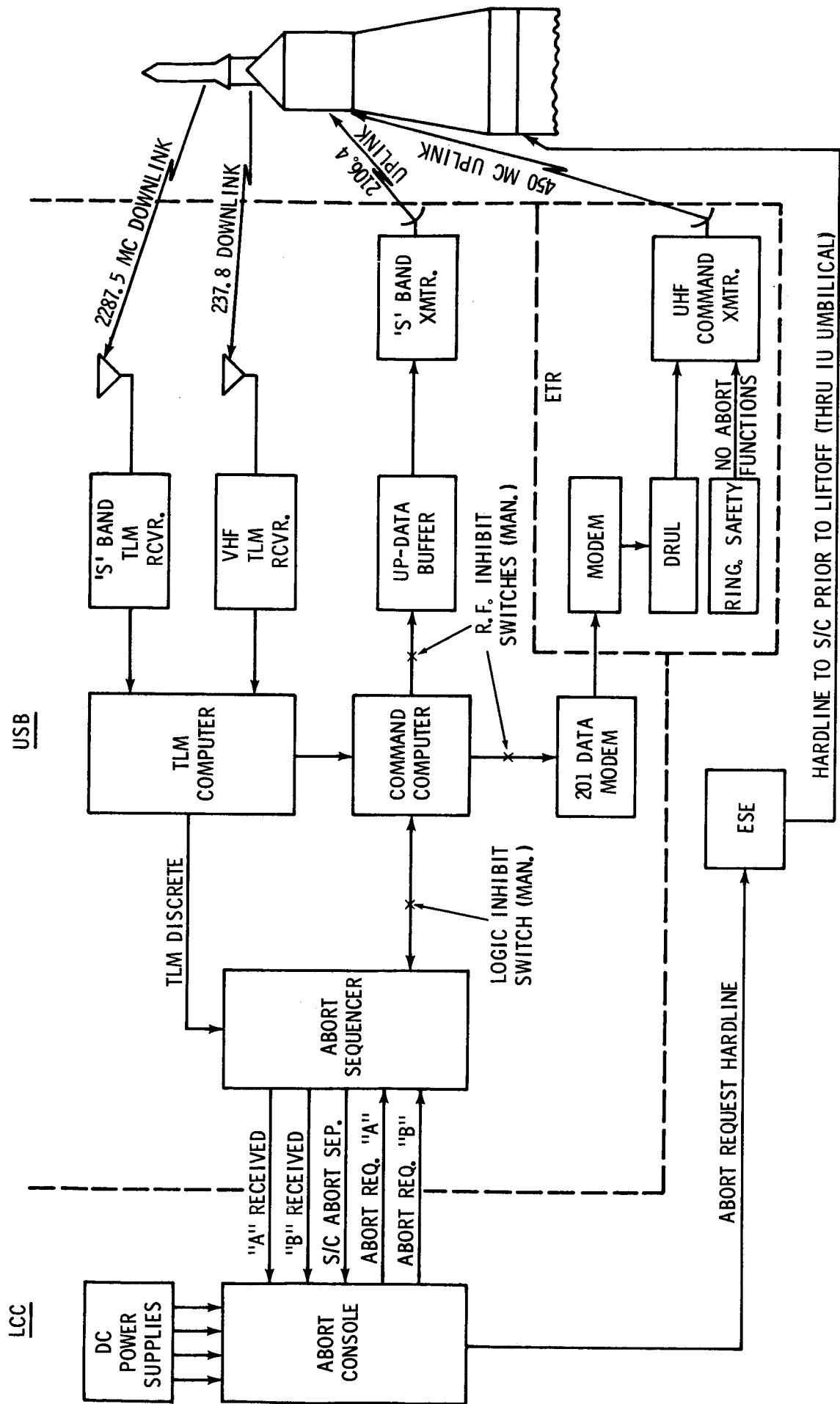
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FIGURE 1 - ABORT REQUEST SIGNAL FLOW

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System (AAS) for AS-502 –
Case 320

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